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University of Maine.

Maine Agricultural Experiment Station

ORONO.

BULLETIN No. 154. APRIL, 1908.

PARIS GREEN. BORDEAUX MIXTURE.

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ORONO, MAINE.

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[310-3-08]

University of Maine.

MAINE
AGRICULTURAL EXPERIMENT STATION,
ORONO, MAINE.

Dear Sir:—

The accompanying bulletin is sent at the request of the Farmers' Institute Specialist of the office of Experiment Stations, United States Department of Agriculture. If you desire to receive further publications of this Station and will write to that effect, your name will be placed upon the Station mailing list and you will receive all bulletins published by this Station bearing upon agricultural investigations.

Requests for the bulletins should be addressed to

Maine Agricultural Experiment Station,
Orono, Maine.

Yours truly,

CHAS. D. WOODS,
DIRECTOR.

March, 1908.

BULLETIN No. 154

PARIS GREEN.

CHAS. D. WOODS and H. H. HANSON.

Paris green is a definite chemical compound known to chemists as aceto-arsenate of copper. It is prepared from verdigris (acetate of copper) and arsenious oxide. When pure it carries 58.65 per cent arsenious oxide; 31.29 per cent copper oxide; and 10.06 per cent acetic acid. The value of Paris green as an insecticide depends upon the arsenic which it contains in combination with copper. The presence of free arsenious acid is harmful as it burns foliage. The ideal Paris green would carry a maximum amount of arsenious oxide in combination with copper; it would have as little as possible of free arsenious acid so as not to burn the foliage; and it would be in the finest possible powder in order that it may readily remain in suspension when mixed in water and that it may be more thoroughly distributed over foliage.

ANALYSES OF PARIS GREEN.

During the past two years the Station has received frequent complaints of the quality of Paris green, which has led to the examination of the samples herewith reported. Analyses of the Paris greens on sale in Connecticut in 1907 were reported by the Connecticut Agricultural Experiment Station, and those on sale in New Jersey by the New Jersey Agricultural Experiment Station.* The results of the analyses made by these respective Stations are here included with analyses made here. This examination of the fineness of many of these samples, which were kindly frunished us by these Stations, were made at the Maine Station and are reported on page 114.

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* Bul. 157 Conn. Station and Bul. 205 N. J. Station.

The table which follows gives the results of the analyses of Paris green made at the Maine, Connecticut and New Jersey Stations in 1907.

TABLE SHOWING THE RESULTS OF ANALYSES OF PARIS GREEN MADE AT THE MAINE, CONNECTICUT AND NEW JERSEY STATIONS IN 1907.

Lab. No.	Name of Brand.	Copper oxide (CuO)	Arsenious oxide (As_2O_3)		
			Total.	Soluble in water in 10 days.	Required to combine with copper.*
N. J. 10	Adler	29.35	58.06	–	54.88
Me. 3324	Ansbacher	31.11	56.08	2.32	58.18
Me. 3416	“	30.20	58.42	2.33	56.47
Me. 3419	“	30.83	57.99	3.55	57.65
C. 19481	“	28.76	57.92	2.92	53.78
C. 18662	“	29.49	57.44	2.44	55.15
N. J. 16	“	30.16	57.43	–	56.40
N. J. 24	“	29.66	56.09	–	55.46
C. 18634	Barry	29.55	57.23	6.82	55.26
C. 18509	“	29.01	56.62	6.82	54.25
Me. 3417	Blanchard	29.73	58.48	3.55	55.59
Me. 3418	“	30.21	58.20	4.17	56.49
C. 18704	“	28.14	57.03	7.31	52.62
N. J. 6	“	30.16	57.80	–	56.40
N. J. 14	“	29.51	56.82	–	55.18
N. J. 20	“	29.67	57.68	–	55.48
N. J. 26	“	28.56	57.68	–	53.41
N. J. 29	Childs & Co	29.31	57.53	–	54.81
N. J. 25	Devoe & Raynolds	25.87	60.02	–	48.38
N. J. 1	H. W. Doughten	29.84	57.31	–	55.80
Me. 3421	Herrmann	30.05	57.80	3.92	56.19
C. 19547	“	28.54	56.20	4.87	53.37
N. J. 3	“	30.00	56.82	–	56.10
N. J. 19	“	30.16	57.56	–	56.40
N. J. 8	Lavanburg	29.84	57.43	–	55.80
N. J. 18	“	30.32	57.56	–	56.70
N. J. 22	“	30.49	57.07	–	57.01
C. 18569	Leggett	27.15	60.61	10.72	50.77
C. 18508	“	29.34	56.83	8.77	54.87
N. J. 27	“	28.83	56.05	–	53.91
N. J. 2	Lucas	30.14	56.20	–	56.20
N. J. 4	“	30.32	56.82	–	56.70
N. J. 7	“	30.00	57.56	–	56.10
N. J. 9	“	29.84	56.82	–	55.80
N. J. 15	“	29.67	56.82	–	55.48
N. J. 17	“	30.16	57.56	–	56.40
C. 18512	Pfeiffer	30.27	56.71	4.38	56.60
N. J. 5	“	29.02	57.19	–	54.27
N. J. 21	“	30.32	57.20	–	56.70
N. J. 23	“	30.16	56.95	–	56.40
Me. 3323	Raynolds	28.90	59.68	7.49	54.04
Me. 3420	“	27.85	61.83	7.96	52.08
C. 18510	“	26.56	60.83	6.32	49.63
C. 18511	“	27.15	61.19	9.74	50.77
C. 18663	Sherwin & Williams	29.88	56.56	2.92	55.88
N. J. 28	“ “ “	30.24	57.66	–	56.55
N. J. 11	Steelman and Archer	30.49	57.31	–	57.01
N. J. 12	“ “ “	29.84	57.68	–	55.80
N. J. 13	“ “ “	30.16	57.43	–	56.40

* On the supposition that Paris Green is copper aceto-arsenate.

ADULTERATIONS OF PARIS GREEN.

Paris Greens have been frequently examined in different parts of the country and while there have been occasional samples that have been found to be adulterated with materials which do not normally enter into the composition of the goods, for the most part, they are free from foreign admixtures. The most dangerour adulteration, if it may be so called, is the presence of an excess of arsenious oxide. This is the cheapest ingredient of Paris green and there is a constant temptation to add as great an excess of arsenious oxide as is possible and obtain a good color. From the standpoint of an insecticide, the presence of an excess of arsenious oxide is serious because it endangers foliage to which the green is applied.

From investigations made at the New Jersey Agricultural Experiment Station,* it is found that there is generally a shortage of weight and that while as a rule the gross weight of the packages is equal to or slightly in excess of what is claimed, they fall short in net weight from 4 to 10 per cent,—that is the purchaser usually pays for the container at the rate of 30 to 35 cents per pound.

ORDINARY IMPURITIES OF PARIS GREEN.

Six samples of Paris green were analyzed at this Station to determine the water, sand and sodium sulphate which they carried. The water ran from 1.14 to 1.50 per cent. A few years ago the Bureau of Chemistry of the U. S. Department of Agriculture analyzed 45 samples of Paris green, and the water run from .33 to 1.24 per cent. It will be noted in these samples, the water has been increased nearly a per cent and while the water in the Paris green does no harm, it is a shortage in weight.

The sand is incidental to the manufacturer but is practically the same as existed in the greens of a few years ago. Sodium sulphate is an impurity incident to the manufacture of Paris green but if the greens are at all carefully washed, there should be considerably less than one per cent. It will be noted in one instance that the sodium sulphate run up to 2.4 per cent. These ordinary impurities average in the 6 samples in the aggregate 2.75 per cent which is double what there should be in well made greens. These impurities will not injure the green in any way for the purpose intended, but they add weight and cause valueless materials to be sold at a high price.

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* Bul. 205 New Jersey Station.

TABLE SHOWING ORDINARY IMPURITIES OF PARIS GREEN.

Station Number.	Brand.	Water.	Sand.	Sodium Sulphate.
		%	%	%
3416	Ansbacher.................	1.50	0.12	0.77
3419	"	1.43	0.12	0.87
3417	Blanchard.................	1.36	0.11	1.98
3418	"	1.21	0.20	2.44
3421	Herrmann.................	1.14	0.08	1.52
3420	Raynolds..................	1.14	0.13	0.41

COPPER OXIDE.

The amount of copper oxide carried by a pure Paris green should be 31.29 per cent. Supposing a green to have 2.75 per cent of impurities, it would then carry 30.42 per cent of copper oxide. While only 4 of the 49 samples carried more than 30.42 per cent of copper oxide, 19 of them carried more than 30 per cent. While the presence of the copper oxide is of no importance in itself, a Paris green cannot carry its full content of green unless the copper oxide is practically up to the theoretical.

ARSENIOUS OXIDE.

A chemically pure Paris green would carry 58.65 per cent of arsenious oxide in combination with copper. Estimating that there would be 2.75 per cent of impurities, there should be 57.05 per cent of arsenious oxide in the green in combination with the copper. Only 15 of the 49 samples carried less than this amount of arsenious oxide; 24 carried between 57 and 58 per cent; 4 samples from 58 to 59; one between 59 and 60; 3 between 60 and 61; and 2 between 61 and 62 per cent arsenious oxide. Viewed from the standpoint of arsenious oxide then, the Paris greens examined would seem to be goods of high grade, but when it is remembered that all the arsenious oxide that is present that is not in combination with copper is a detriment and a danger, it is important to see how much of this arsenious oxide is soluble in water.

The burning effect of a Paris green upon foliage seems to depend upon the amount of water soluble arsenic it carries. The amount of arsenic that goes into solution varies with the time to which it is exposed to the water and to the fineness of the green, and with the care that is used in the manufacture of the green. The Connecticut Experiment Station determined the amount of arsenious oxide soluble in water when the green was treated one day and when treated 10 days and found that there was from 2 to 4 times as much arsenious oxide dissolved in 10 days as in one day. Investigations by the Bureau of Chemistry of the U. S. Department of Agriculture* have shown that with the water extraction method, some of the combined arsenious oxide and copper go into solution. This, however, was found to be due to a breaking down of the Paris green and in the case of well made Paris greens there was very much less of the combined arsenious oxide that went into solution, and it is evident from their examinations that it is possible to make Paris greens which can be ground very fine and will give a low figure for water soluble arsenious oxide and it is this class of greens that are desirable as insecticides.

The last column of the table on page 110 gives the amount of arsenious oxide which the copper present in the samples required. In 3 or 4 instances it will be noted that this amount is larger than the arsenious oxide actually found in the sample, showing that there was an excess of copper oxide present. As a rule, however, it is the arsenious oxide that is present in excess; so much so that in 3 of the samples which were examined under the microscope, a large amount of arsenious oxide was seen present in white crystals. See table on page 114.

FINENESS OF PARIS GREEN.

In the case of most insecticides, the smallest possible particle of poison would be a fatal dose to an insect. It is obvious then that the fineness of the Paris green is very important because not only the finer the green the better it will stay in suspension, but also the finer the green, the greater is the number of particles and hence, theoretically, the larger number of insects that may be killed with a definite weight of green. In some of the early work by the Gypsy Moth Commission in Massachusetts it was found that the Paris greens upon the market were so coarse that even in the very destructive feeding of the gypsy moth, the particles were too large to be taken into the mouth of that insect and hence it could feed upon sprayed foliage with impunity. Finding that all of the greens on sale in Maine carried sufficient arsenic, an examination of some samples was made to determine the relative fineness. The results are given in the following table.

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* Bul. 68, Bureau of Chem., U. S. Dept. Agr.

TABLE OF COMPARATIVE FINENESS OF PARIS GREENS.

Sta. No.	Make of Paris Green.	Particles counted.	Particles with diam. of 19.2 or more microns	Percentage of particles with diam. 19.2 or more microns.	Remarks.
N. J. 10	Adler	2345	16	0.68	
Me. 3324	Ansbacher	1039	58	5.58	
Me. 3416	Ansbacher	463	50	10.80	
Me. 3419	Ansbacher	664	48	7.23	
Conn. 18509	Barry	4537	14	0.31	
Me 3417.	Blanchard	544	16	2.94	
Me. 3418	Blanchard	597	8	1.34	
N. J. 29	Childs	1750	21	1.20	
N. J. 25	Devo-Raynolds	760	137	18.03	12.15% of particle counted in 15 fields As_2O_3 crystals.
Me. 3421	Herrmann	845	34	4.02	
N. J. 8	Lavanburg	1668	51	3.06	
N. J. 18	Lavanburg	963	45	4.67	
Conn. 18508	Leggett	1617	21	1.30	
N. J. 2	Lucas	1078	58	5.38	
Conn. 18512	Pfeiffer	1014	58	5.72	
N. J. 5	Pfeiffer	2229	28	1.26	
N. J. 21	Pfeiffer	1202	94	7.82	
Me 3323	Raynolds	641	21	3.28	5.96% of particles counted in 15 fields As_2O_3 crystals.
Me. 3420	Raynolds	360	59	16.39	7.54% of particles counted in 15 fields As_2O_3 crystals.
Conn. 18663	Sherwin-Williams	2196	26	1.18	Many small irregular particles.
N. J. 28	Sherwin-Williams	840	71	8.45	

Under the microscope it was found that the particles of Paris green were all quite regularly rounded and on this account were comparatively easy to measure. Several different kinds were examined and the largest particles in different fields were counted and notes made of the different diameters. It was found that the average diameter of about 250 of these large particles was 6.3 of the divisions in the micrometer eye piece used. In this work the best results were obtained by using a 1-inch micrometer eyepiece with a 1-6 objective and this combination was used throughout the determinations. On calibration it was found that 6 divisions of the micrometer scale equalled 19.2 microns, which has a value of .00077 of an inch. An examination of the green showed that there was a general gradation and that as a rule the larger the number of coarse particles, the coarser the whole green was. This was taken as the limit and all particles in the fields larger than 19.2 microns were counted. The greens were mounted in olive oil and examined without delay after mounting and 25 fields of these were counted and examined in each case.

RELATIVE FINENESS AND WATER SOLUBLE ARSENIC.

In the table which follows the relative fineness and percentages of water soluble arsenic in Maine collected samples are shown.

SUMMARY TABLE SHOWING RELATIVE FINENESS AND WATER SOLUBLE ARSENIC IN 4 BRANDS OF PARIS GREEN SOLD IN MAINE.

Station No.	Brand.	Year purchased.	Particles with diameter of 19.2 or more microns.	Water soluble arsenious oxide.
			Percent	Per cent
3324	Ansbacher	1906	5.6	2.32
3416	Ansbacher	1907	10.8	2.33
3419	Ansbacher	1907	7.2	3.55
3417	Blanchard	1907	2.9	3.55
3418	Blanchard	1907	1.3	4.17
3421	Herman	1907	4.0	3.92
3323	Raynolds	1906	3.3	7.49
3420	Raynolds	1907	16.4	7.96

There is no law in this State regulating the sale of Paris green but where a state inspection is in effect the requirements are generally very similar to those in the New Jersey law,* section 3 of which reads:

"Paris green, or any product analogous to it, when sold, offered or exposed for sale as such, in this State shall comply with the following requirements:

First. It shall contain arsenic, in combination with copper, equivalent to not less than fifty per centum arsenious oxide.

Second. It shall not contain arsenic in water-soluble forms equivalent to more than three and one-half per centum of arsenious oxide."

In the case of the Ansbacher and Raynolds greens, the samples obtained in 1907 were not as finely powdered as those of 1906. The large amount of water soluble arsenic as shown by both the microscope and by chemical analysis, as well as the relative coarseness of the particles make Raynold's greens the least desirable of the 4 brands found on sale in Maine. The reported cases of burning of foliage and failure to kill the potato bugs reported from some users of Raynolds green may perhaps be explained by these analyses. As noted above it is unlawful in the state of New Jersey to sell a Paris green carrying more than 3½ per cent water soluble arsenious oxide. Raynolds greens were found to carry more than double that amount.

HOW TO USE PARIS GREEN.

Paris green is more economically applied with water than any other way. It should always be applied with lime to diminish danger of injury to foliage. If green of good quality is used, one-half pound to 50 gallons of water is sufficiently strong if used just *before* slugs or caterpillars appear.

The following formulas for fungous enemies and insects which chew, are those that have been recommended by this Station for many years.

Formula 3. PARIS GREEN.

For insects that chew.

Paris Green	½ pound
Lime (unslaked)	3 pounds
Water	50 gallons

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* Bul. 205, N. J. Station.

The standard remedy for the destruction of insects which eat the foliage or fruit. The lime is added to prevent the Paris green from burning the foliage. Slake the lime in a little water, make into a thin paste and strain. Wet the Paris green with a little water and make into a thin paste. Mix the lime and Paris green and add the remainder of the water.

Formula 6. BORDEAUX MIXTURE.

For potato blight and other fungous diseases.

Copper Sulphate	5 pounds
Fresh Lime (unslaked)	5 pounds
Water	50 gallons

The copper salt is dissolved in a wooden tub or earthern jar and the lime slaked in a separate vessel. Dissolve the copper sulphate ("Blue Stone") in about two gallons of hot water in a wooden or earthern vessel by stirring, or by suspending it from the top of the vessel in a cloth bag; pour the solution into the tank or barrel used for spraying and fill one-third to one-half full of water. Slake the lime by the addition of a small quantity of water, and when slaked add 10 or 15 gallons of water and stir freely. Pour the milk of lime thus made into the sulphate solution, passing it through a brass wire strainer of about 30 meshes to the inch (No. 50) or through cheese-cloth backed by common window screen. Stir constantly while adding the lime. Add water to make the amount desired.

Much time may be saved by preparing stock solutions. While other proportions may be used, the following is a convenient method of preparing the mixture:

The stock solution of copper sulphate is made by weighing out 50 pounds of copper sulphate, placing it in a bag and suspending it in the top of a barrel containing 30 gallons of water. The copper sulphate dissolves completely in a few hours. The stock solution of the lime is prepared by slaking 50 pounds of lime, and adding water so as to make up 30 gallons and straining through No. 50 brass screen cloth. To slake and strain this amount of lime takes less than one-half hour. For use, 3 gallons of each solution and 44 gallons of water make up the formula given above. The stock solutions should be kept well cov ered and be *thoroughly stirred before dipping out.*

Prepared lime for Bordeaux mixture is offered by some dealers. This if *strictly fresh* may be substituted for the unslaked lime and thus some time and trouble saved. "Pine Cone" brand is the only one yet tried at this Station. It will be found safe to use 6 or 7 pounds of prepared lime in place of the 5 pounds of quick lime.

Formula 7. PARIS GREEN AND BORDEAUX MIXTURE.

A combination of formulas 3 and 6.

Paris Green	½ pound
Bordeaux Mixture	50 gallons

PREPARED BORDEAUX MIXTURE.

CHAS. D. WOODS and H. H. HANSON.

For many years prepared Bordeaux mixtures both wet and dry have been on the market. As considerable dry mixtures were used in Maine in 1907 and the question of ready to use wet mixtures seemed to be more to the front than for several years, samples of the principal mixtures were obtained and analyzed for their copper content. The results are given in the table which follows.

TABLE SHOWING PERCENTAGES OF COPPER SULPHATE IN PREPARED BORDEAUX MIXTURES.

Station No.	Brand	Copper sulphate*
	Dry Preparations	Per cent
3412	Leggetts Dry Bordeaux (Fungiroid) (1)	51.5
3423	Leggetts Dry Blight Dust No. 2 (1)	26.9
3424	Leggetts Dry Blight Dust No. 2 (1)	28.1
3425	Bowker's Boxal (2)	42.0
3427	Sal Bordeaux (3)	37.9
	Wet Preparations	
3426	Bowker's Wet Bordeaux (2)	7.9
3415	Bowker's Paste Boxal (2)	21.6
3413	Blanchard's Lion Brand Bordeaux Mixture (4)	17.5
3414	Swift's Bordeaux Mixture (5)	76.5

(1) Made by Leggett & Bro., New York..

(2) Made by Bowker Insecticide Co., Boston.

(3) Made by Dust Sprayer Manufacturing Co., Kansas City, Mo.

(4) Made by James A. Blanchard, New York City.

(5) Made by Merrimac Chemical Co., Boston.

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*Crystalized copper sulphate carrying 5 molecules of water.

THE EFFECTIVENESS OF PREPARED BORDEAUX MIXTURES, WET AND DRY COMPARED WITH FRESHLY PREPARED.

Wet read-to-use Bordeaux mixtures were compared with freshly prepared Bordeaux mixtures by the Station in 1900 * with the result that when these mixtures were used according to directions, the results were not as effective as the freshly prepared Bordeaux mixture. This was probably due to the fact that when the directions are followed, a much smaller amount of copper is used per acre than in the freshly prepared Bordeaux.

In one instance in 1900 a ready prepared Bordeaux mixture was used in sufficient quantity to furnish as much copper as is carried by ordinary Bordeaux mixture.

The results of the experiments indicated that ready prepared Bordeaux mixtures were about as effective as freshly made goods *provided they were used in such amounts as to supply an equal amount of copper.*

In 1907, a field experiment was made on quite a large scale the primary object of which was to compare dust spraying with wet Bordeaux. However one ready prepared wet Bordeaux (Boxal) was used. The results are reported in detail in Bulletin 149 of this Station and are shown graphically on the opposite page.

So far as the results of the experiments show, none of the substitutes for wet bordeaux in any way approached it in efficiency as a preventive for late blight. While none of the dust sprays in any way produced the results claimed for them by the manufacturers and others, they all showed more or less fungicidal value. This was least with Leggett's Blight Dust No. 2 and Bowker's Dry Boxal, which only showed a gain of 18 or 20 bushels per acre resulting from 6 applications of 6 pounds each, when compared with the unsprayed check. The same amount of Dust Sprayer Manufacturing Co's. Sal Bordeaux increased the yield 60 bushels per acre, while 10 pounds of the same material to an application gave an increase of 102 bushels per acre. The fact should not be overlooked that wet bordeaux under the same conditions gave an increase of 168 bushels per acre.

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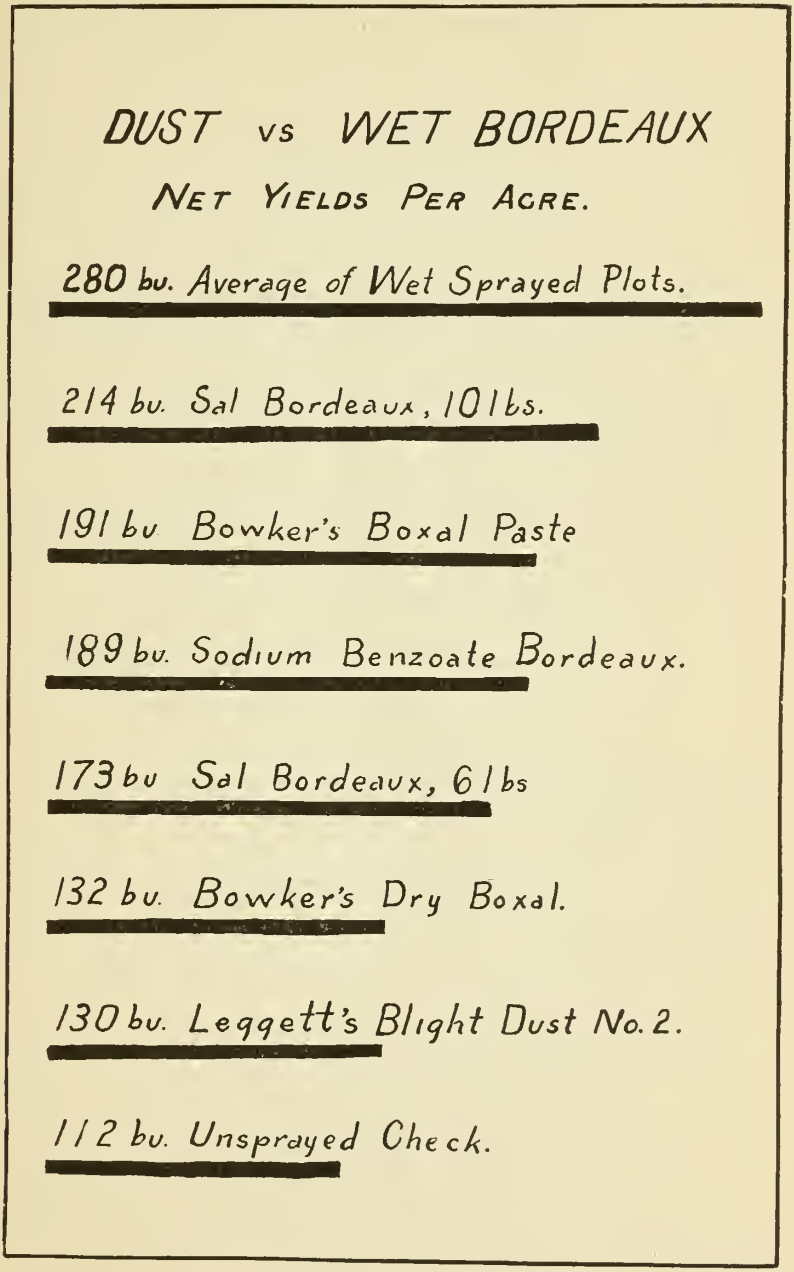
* Bulletin 73, Maine Station.

DIAGRAM SHOWING RESULTS OF A FIELD EXPERIMENT IN 1907.



These experiments indicate that wet ready-to-use Bordeaux mixture cannot be depended upon to prevent blight unless used in quantities much larger than the directions call for and that dry Bordeaux mixtures are not nearly as effective as wet Bordeaux.

COPPER CONTENT OF PREPARED COMPARED WITH REGULAR BORDEAUX MIXTURE.

As may be noted in the table on page 120 prepared wet Bordeaux mixtures differ greatly in the amount of copper they carry. Even if they are equally efficient, in comparing their cost with that of freshly prepared Bordeaux mixture, the amount of copper carried must be taken into account. The following table shows the number of pounds of each that needs to be taken to furnish an amount of copper equivalent to that furnished by a barrel of Bordeaux mixture made up from 5 pounds of copper sulphate, 5 pounds of lime and 50 gallons of water.

TABLE SHOWING POUNDS OF DIFFERENT PREPARED BORDEAUX MIXTURES EQUIVALENT TO A BORDEAUX MIXTURE CARRYING 5 POUNDS COPPER SULPHATE.

Brand.	Pounds equal to 5 pounds copper sulphate.
Dry Preparations.	
Leggetts Dry Bordeaux (Fungiroid)	9.7
Leggetts Blight Dust No. 2	18.2
Bowker's Dry Boxal	11.9
Sal Bordeaux	13.2
Wet Preparations.	
Bowker's Wet Bordeaux	63.3
Bowker's Paste Boxal	23.1
Blanchard's Lion Brand Bordeaux	28.2
Swift's Bordeaux Mixture	6.5

MONEY VALUE PER POUND OF PREPARED COMPARED WITH REGULAR BORDEAUX MIXTURE.

The cost of preparing fresh Bordeaux mixture in 10 barrel lots does not exceed 75 cents a barrel, taking cost of materials and time of preparation into account, and it can probably be made for not much if any more than 50 cents. The table which follows shows the price per pound one could afford to pay for the ready made goods, assuming that freshly prepared Bordeaux mixture carrying 5 pounds lime, and 5 pounds of copper sulphate costs either 50 or 75 cents a barrel. This would of course, if all the cost of materials and preparation is thrown upon the copper, make a pound of copper sulphate in freshly prepared Bordeaux mixture equal 10 cents in one instance and 15 cents in the other.

TABLE SHOWING VALUE PER POUND OF PREPARED BORDEAUX MIXTURES COMPARED WITH FRESHLY PREPARED BORDEAUX MIXTURE AT 50 AND AT 75 CENTS A BARREL.

Brand.	Value per pound at 50 cents a barrel.	Value per pound at 75 cents a barrel.
	CENTS.	CENTS.
Bowker's Wet Bordeaux	0.8	1.2
Bowker's Paste Boxal	2.2*	3.2*
Blanchard's Lion Brand Bordeaux	1.7	2.6
Swifts' Bordeaux Mixture	7.7	11.5

*This preparation carries an insecticide which adds to its value.

Bulletin 73 of this Station contains the following relative to the use and cost of Bordeaux mixture.

"The claim is justly made by the manufacturers that the prepared Bordeaux mixtures are ready for use, since they only need to be diluted with the requisite amount of water. If one is using much Bordeaux mixture this is of little practical importance; for by using stock solutions freshly prepared Bordeaux mixture (with allowance for time of preparing stock solution) can be as quickly prepared as the ready made goods can be stirred up and diluted."

"The materials for making a barrel (50 gallons) of Bordeaux mixture costs between 40 and 50 cents. The prepared goods *of this strength* are practically as good as the freshly prepared. The small grower will probably find the ready made goods enough more convenient to justify a somewhat higher cost. The large grower should not with present prices pay much more than at the rate of 50 cents for enough material to make a barrel of the mixture. The trouble of preparing the mixture from lime and sulphate of copper is slight. Enough lime to make 10 barrels of the mixture was weighed out, slacked and strained by the writer in 23 minutes. Making the copper sulphate solution takes practically no labor, although it will be several hours after it is suspended in the water before it will be all dissolved."

It is true today as when the above was written that the large grower rarely, if ever, can afford to purchase prepared wet Bordeaux mixtures at any price at which they have been or can be offered. It is also true that, to say the least, freshly prepared Bordeaux mixture is in fully as good form to serve as a fungicide as old mixture. It apparently adheres to foliage better than old. There seems, therefore, to be little or no reason for the large grower to use ready made wet Bordeaux mixture. The experiments conducted at this Station clearly indicate the unwisdom of dust spraying for potatoes. Until some marked advance shall have been made in the preparation of commercial Bordeaux mixtures, wet or dry, they do not seem to fit in to the economical and effective combatting of the fungous diseases of the potatoes.

SPECIAL SPRAYING DIRECTIONS.

The Station has issued the following publications on treatment of special crops for insects and fungi, which will be sent to any address on application.

How to Fight Apple Enemies.
How to Fight Cucumber Enemies.
How to Fight Potato Enemies.
Oat Smut and its Prevention.

Requests for Station publications should be addressed to the
Maine Agricultural Experiment Station,
Orono, Maine.